

Application No. 09/921,358

Reply to Office Action

*REMARKS/ARGUMENTS**The Present Invention and the Pending Claims*

Claims 1-5, 7, and 18 are pending and are directed to a flexible metal-clad laminate (claims 1-5, and 7) and a flexible printed wiring board comprising the flexible metal-clad laminate (claim 18).

The flexible metal-clad laminate of the present invention is characterized by: (1) a heat-resistant resin layer having a N-methyl-2-pyrrolidone-insoluble content of at least 1% (i.e., the resin layer has a specific degree of crosslinking), and (2) the average surface roughness Ra of the surface of the heat-resistant resin layer which is in contact with the metal foil is not more than 0.4  $\mu\text{m}$ . With these properties, curling in the flexible metal-clad laminate can be prevented, even though the thickness of the metal foil is as thin as 3  $\mu\text{m}$  to 50  $\mu\text{m}$  and the metal-clad laminate is prepared by applying a solution to a substrate and drying the solution (see Table 2 on page 48). Since the average surface roughness Ra of the surface of the heat-resistant resin layer in contact with the metal foil is 0.4  $\mu\text{m}$  or less, the heat-resistant resin film layer does not curl even after the removal of the metal foil by etching (see page 33, lines 3-6, and page 46, lines 21-25). Accordingly, the present invention has successfully achieved prevention of curling of the laminate, as described above, as well as in the heat-resistant resin layer after the removal of a metal foil by etching, due to the specific insoluble content (an index showing the degree of crosslinking in a resin) and the average surface roughness Ra of the heat-resistant resin layer of the flexible metal-clad laminate.

*Amendments to the Claims*

Claims 19-26 have been canceled. No new matter has been added by way of these amendments.

*Summary of the Office Action*

The Examiner has now considered the signed Rule 132 Declaration, filed June 23, 2005, wherein Applicants showed that the process taught in the Frost reference does not result in the required insoluble polymer content. The Examiner also has considered Applicants' arguments filed in the "Reply to Office Action" dated June 16, 2005. However, according to the Examiner, both the Rule 132 Declaration and Applicants' arguments are moot in view of a new rejection. The Examiner has rejected all of the remaining pending claims under 35 U.S.C. § 103(a) as allegedly unpatentable over Watanabe et al. (U.S. Patent

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3,936,575) in view of Frost (U.S. Patent 3,984,375), Akahoshi et al. (U.S. Patent 4,970,107), and Lu (U.S. Patent 3,897,393). Reconsideration of this rejection is hereby requested.

*Discussion of the Obviousness Rejection*

*(A) The Watanabe Reference*

According to the Examiner, the Watanabe reference teaches a metal-clad laminate for flexible printed circuit boards using conductive foils with a thickness of 15-110  $\mu\text{m}$ . More specifically, the Watanabe reference discloses (1) a flexible metal-clad laminate in which an epoxy resin is laminated on a metal foil, and (2) obtaining the laminate by impregnating a fibrous substrate with an epoxy resin, and bonding the impregnated base to a metal foil under heat and pressure by means of a roll-laminator (see col. 1, lines 17-4, col. 3, lines 28-35, and col. 13, lines 9-46).

*(B) The Frost Reference*

The Examiner has acknowledged that the Watanabe reference neither teaches nor suggests the polyamide-imide resin required in the present invention as defined by the pending claims. The Examiner alleges that the Frost reference remedies this deficiency by teaching the required polymer. However, in view of the cancellation of claims 19-26, the Frost reference does not teach or suggest the polyamide-imide resin required by the pending claims. The Frost reference teaches a polymer having an unsubstituted diphenyl linker (col. 2, line 11) whereas the polymer required in the pending claims has a specific structure in which the linker is substituted with methyl groups in the 3 and 3' positions. Further, Applicants would like to remind the Examiner of the May 9, 2005 telephone interview, during which the Frost reference was discussed with respect to the polyamide-imide of claim 1. In the Examiner Interview Summary Record dated May 13, 2005, the Examiner stated: "Agreement was reached that Frost does not teach the polymer of claim 1." Accordingly, the Frost reference does not remedy the deficiencies of the Watanabe reference.

*(C) The Akahoshi Reference*

The Examiner has acknowledged that neither the Watanabe reference nor the Frost reference teaches the claimed surface roughness of the heat-resistant resin film layer. However, the Examiner contends that the Akahoshi reference remedies the deficiencies of the Watanabe and Frost references. According to the Examiner, the surface roughness of a copper layer described in the Akahoshi reference is equivalent to the surface roughness of the resin film layer of the present invention as defined by the pending claims. This assertion by

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the Examiner appears to be in contrast to the view taken in the telephone interview of May 9, 2005, wherein the Examiner admitted that the surface roughness taught in the Akahoshi reference may not be comparable to the surface roughness required by the pending claims.

Nonetheless, Applicants stress that the Akahoshi reference teaches that the surface roughness of a *copper layer* is from 0.1 to 1.0  $\mu\text{m}$  due to etching (col. 1, lines 34-46) so as to improve adhesion. Nowhere in the disclosure of the Akahoshi reference is there a discussion of the roughness of a heat-resistant *resin film layer* as recited in the pending claims. The surface roughness of the resin layer is *not* the same as the surface roughness of the substrate layer (i.e., a metal foil). One of ordinary skill in the art would recognize that it would not be possible to obtain a resin layer with the surface roughness required by the pending claims by merely replicating the surface roughness of a foil layer. Accordingly and contrary to the Examiner's assertion, the Akahoshi reference does not teach the roughness of a resin layer. In addition, the Akahoshi reference does not teach or suggest the claimed polyamide-imide resin which contains methyl groups in the 3 and 3' positions of the diphenyl linker. Therefore, the Akahoshi reference does not remedy the deficiencies of the Watanabe and Frost references.

(D) *The Lu Reference*

The Examiner has acknowledged that neither the Watanabe reference nor the Frost reference teaches the insoluble polymer content required by the pending claims. Similarly, there is no teaching or suggestion in the Akahoshi reference which would motivate one of skill in the art to adjust the insoluble content of a polyamide-imide resin to 1% or higher. The Examiner alleges that the newly cited Lu reference remedies the deficiencies of the previously cited references by teaching that polyimide polymers become insoluble in cresol when cured at elevated temperatures (col. 4, lines 54+). According to the Examiner, it would have been obvious to one of ordinary skill in the art to cure the polymers taught by the Frost reference in the manner disclosed in the Lu reference to afford polymers which inherently meet the claimed insoluble content limitations.

However, as discussed above, the Frost reference does not teach or suggest the polyamide-imide resin required by the pending claims. Similarly, neither the Watanabe nor the Akahoshi references teach or suggest the polyamide-imide resin required by the pending claims. The only polymers disclosed in the Lu reference are polyimides of a bismaleimide and a difunctional herocyclic dissecondary amine (see, for example, col. 1, lines 9-12, and the Examples). These polyimide polymers have significant structural and chemical distinctions from the polyamide-imide required in the pending claims. As such, the Lu reference does not

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disclose the claimed polymer resin and, accordingly, does not remedy all of the deficiencies of the previously cited references.

Moreover, even if the cited references did in fact disclose the polyamide-imide required by the pending claims, the newly cited Lu reference does not specifically teach that the N-methyl-2-pyrrolidone-insoluble content of a heat resistant resin film is at least 1% (i.e., the film contains crosslinking structure of at least 1%). As previously demonstrated in the arguments, accompanying article, and Rule 132 Declaration made of record in the "Reply to Office Action" dated June 16, 2005, an "insoluble content of 1% or higher" is of significant importance when considering the prevention of laminate and resin layer curling and requires a considerably advanced crosslinking reaction. Likewise, nothing in the Lu reference teaches or suggests that such an insoluble content is effective for preventing curling in the flexible metal-clad laminate. Accordingly, there would be no motivation for one of ordinary skill in the art to utilize the teachings of the Lu reference so as to produce a metal-clad laminate which has a radius of curvature of at least 15 cm, as required by the pending claims.

*(E) Combination of the Watanabe, Frost, Akahoshi, and Lu References*

As described above, the cited references, even in combination, do not disclose all the elements of the pending claims, particularly (1) the polyamide-imide resin, (2) the average surface roughness of the heat-resistant resin film layer which is in contact with the metal foil is 0.4  $\mu\text{m}$  or less, and (3) the insoluble content is at least 1% (i.e., the resin layer has a specific crosslinking degree). Moreover, in addition to the foregoing elements, the present invention, as defined by the pending claims, provides unexpected benefits (i.e., curling prevention). As a result, the cited references cannot be considered to render obvious the flexible metal-clad laminate of the pending claims. Accordingly, the obviousness rejection of the pending claims based on the combination of the Watanabe, Frost, Akahoshi, and Lu references is improper and should be withdrawn.


*Conclusion*

Applicants respectfully submit that the present application is in condition for allowance. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

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